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10/524,325

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Rodney J Allam

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09/04/2007

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.

P.O. BOX 2938

MINNEAPOLIS, MN 55402

EXAMINER

LEUNG, JENNIFER A

ART UNIT

PAPER NUMBER

1764

MAIL DATE

DELIVERY MODE

09/04/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/524,325

Applicant(s)

ALLAM ET AL.

Examiner

Jennifer A. Leung

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1764

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 19 June 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-19, 21-25 and 27-29 is/are pending in the application.
- 4a) Of the above claim(s) 1-18 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 19, 21-25 and 27-29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☒ Claim(s) 1-19, 21-25 and 27-29 are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 11 February 2005 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
- 1) ☐ Certified copies of the priority documents have been received.
 - 2) ☐ Certified copies of the priority documents have been received in Application No. _____.
 - 3) ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

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DETAILED ACTION

Response to Amendment

1. Applicant's amendment submitted on June 19, 2007 has been received and carefully considered. The changes made to the Specification are acceptable. Claims 1-18 are withdrawn from consideration. Claims 20 and 26 are cancelled. Claims 19, 21-25 and 27-29 are under consideration.

Drawings

2. Figure 1 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any

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evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 19, 22-24 and 27-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Banquy (US 4,782,096) in view of Davis et al. ("Cryogenics for Syngas Processing", *Chemical Engineering Progress*, February 1980, pages 72-79) and Martin (US 4,102,659).

Regarding claim 19, Banquy (FIGs. 1-5) discloses an apparatus comprising:
a syngas generation system (i.e., comprising a "primary steam reforming" zone and a "secondary oxygen reforming" zone; in detail in FIG. 2) generating syngas 11 by reaction of methane 2 with steam 5 and/or an oxidant comprising oxygen 8, (see, for example, column 6, line 19 to column 9, line 3);
a syngas conversion system (i.e., a "synthesis loop"; in detail in FIG. 3) converting syngas 11 into higher molecular weight hydrocarbon compounds or oxygenates 14 and producing an offgas 15, (see, for example, column 9, lines 13-46); and
a "physical separation" zone for separating the various components contained in the offgas 15 produced by the syngas conversion system.

Banquy discloses that "[a]ny physical separation process can be used" in the physical separation zone and, in particular, "[t]he physical separation can... be achieved by cryogenic techniques, or distillation at low temperature, such as outlined in *Chemical Engineering Progress*, February 1980, pages 72-79 ..." (see column 9, lines 55-68), to Davis et al.

Looking to the cited article, Davis et al. teaches a physical separation zone (Figure 2, showing the "methane wash approach") comprising a cryogenic separation system (i.e., a

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methane wash column) that produces a hydrogen product stream (i.e., in the overhead) and a first cryogenic liquid stream comprising unreacted CO (i.e., in the bottoms); and a cryogenic distillation column (i.e., CO/CH₄ fractionator) for separating unreacted carbon monoxide from the first cryogenic liquid stream to produce a separated CO product (i.e., in the overhead) and substantially carbon monoxide-free cryogenic liquid (i.e., in the bottoms); (see also page 74, beginning of column 2, to page 75, end of column 1).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to provide the physical separation zone as taught by Davis et al. in the apparatus Banquy, on the basis of suitability for the intended use thereof, because any physical separation process can be used, and the physical separation process conducted in the physical separation zone of Davis et al. is specifically suggested as being suitable for use in the apparatus, according to Banquy, above.

The collective teaching of Banquy and Davis et al., however, is silent as to the provision of a second liquid methane wash column.

Martin (FIG. 1; column 7, line 49 to column 9, line 64) teaches the provision of a second liquid methane wash column (i.e., a second absorption zone **19**), to be located between a cryogenic separation system (i.e., a first liquid methane wash column defined by a first absorption zone **15**) and a cryogenic distillation column (i.e., a fractionation zone **27**), wherein the second liquid methane wash column **19** separates unreacted hydrogen from the cryogenic liquid to produce a separated hydrogen fuel by-product (i.e., residual H₂ in line **88**) and a second cryogenic liquid comprising unreacted carbon monoxide (i.e., the liquid in line **21**), to be fed to the cryogenic distillation column **27**.

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It would have been obvious for one of ordinary skill in the art at the time the invention was made to provide a second liquid methane wash column between the methane wash column and the cryogenic distillation column in the modified apparatus of Banquy, on the basis of suitability for the intended use thereof, because the second methane wash column achieves a substantial and unexpected improvement in recovery of high purity carbon monoxide relative to the prior art processes used for such separation, as taught by Martin (see, for example, column 5, lines 31-42).

Regarding claim 22, Banquy discloses (see column 9, lines 47-54, with emphasis added),

“The purge gas (stream 15) extracted from the synthesis loop is subjected to a physical separation to split it into a hydrogen-rich stream, a portion of which will be mixed with the raw synthesis gas to form the final synthesis gas, and *a residual gas stream which contains essentially methane, carbon oxides, argon, nitrogen and some hydrogen, and which can be used as fuel in the primary steam reformer.*”

Therefore, it would have been obvious for one of ordinary skill in the art at the time the invention was made to provide a conduit means for feeding separated carbon monoxide product from the physical separation zone to the syngas conversion system in the modified apparatus of Banquy, because the provision of conduit means for enabling the transport of fluids between different zones of an apparatus is conventional in the art, and such conduit means would enable the separated carbon monoxide product (i.e., the carbon oxides from the residual gas stream) to be recycled as fuel to the primary steam reformer, as specifically suggested by Banquy, above.

Regarding claim 23, Banquy further discloses that the residual gas stream contains argon (see column 9, lines 46-54). Thus, the modified apparatus of Banquy inherently comprises a conduit means for removing an argon-enriched stream from a location in the region of high

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argon concentration in the cryogenic distillation column (i.e., via the bottoms conduit of the CO/CH₄ fractionator to the fuel discharge line, since argon is a higher boiling component relative to the lower boiling component of carbon monoxide; see FIG. 2 of Davis et al.).

Regarding claim 24, Banquy discloses (see column 9, lines 47-54, with emphasis added),

“The purge gas (stream 15) extracted from the synthesis loop is subjected to a physical separation to split it into a hydrogen-rich stream, a portion of which will be mixed with the raw synthesis gas to form the final synthesis gas, and a residual gas stream which contains essentially methane, carbon oxides, argon, nitrogen and some hydrogen, and which can be used as fuel in the primary steam reformer.”

Therefore, it would have been obvious for one of ordinary skill in the art at the time the invention was made to provide a conduit means for feeding separated methane product from the physical separation zone to the syngas conversion system in the modified apparatus of Banquy, because the provision of conduit means for enabling the transport of fluids between different zones of an apparatus is conventional in the art, and such conduit means would enable the methane product (i.e., methane from the residual gas stream) to be recycled as fuel to the primary steam reformer, as specifically suggested by Banquy, above.

Regarding claim 27, Banquy (see column 9, lines 47-54, with emphasis added) discloses,

“The purge gas (stream 15) extracted from the synthesis loop is subjected to a physical separation to split it into a hydrogen-rich stream, a portion of which will be mixed with the raw synthesis gas to form the final synthesis gas, and a residual gas stream which contains essentially methane, carbon oxides, argon, nitrogen and some hydrogen, and which can be used as fuel in the primary steam reformer.”

As seen in FIGs. 1, 4 and 5, the apparatus further comprises conduit means 12 for removing a portion of the separated hydrogen product, in order to recycle the hydrogen to the syngas

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conversion system (i.e., the synthesis loop) for generation of higher molecular weight hydrocarbon compounds or oxygenates **14**. Please note that the recitation of a particular molar concentration of helium within the separated hydrogen product stream is considered a process limitation that adds no further patentable weight to the apparatus claim.

Regarding claim 28, as best understood, Banquy (FIG. 2) discloses that the syngas generation system comprises a partial oxidation reactor (i.e., a secondary oxygen reformer **R**; column 7, lines 3-42) and an enhanced heat transfer reformer (i.e., an endothermic primary steam reforming reactor **F**, having catalyst containing reforming tubes heated externally by burners; see column 6, lines 43-64).

Regarding claim 29, Banquy discloses that the syngas conversion system comprises at least one FT reactor (i.e., a synthesis converter **SC**, for reacting hydrogen with carbon monoxide, carbon dioxide or mixtures of these carbon oxides, a.k.a. Fischer-Tropsch synthesis, to yield methanol), (see FIG. 3; see column 9, lines 4-46).

4. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Banquy (US 4,782,096) in view of Davis et al. ("Cryogenics for Syngas Processing", *Chemical Engineering Progress*, February 1980, pages 72-79) and Martin (US 4,102,659), as applied to claim 19 above, and further in view of Ireland et al. (US 4,044,063).

The collective teaching of Banquy, Davis et al. and Martin is silent as to the apparatus further comprising a hydrogenation system.

Ireland et al. (FIG. 1; see, for example, column 8, line 15 to column 9, line 3) teaches a hydrogenation system (e.g., hydrotreating unit **56**; or hydrodewaxing unit **62**) for hydrogenating a fraction of the higher molecular weight hydrocarbon compounds **54**, **60** produced by a syngas

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conversion system (i.e., in F-T synthesis zone 4). It would have been obvious for one of ordinary skill in the art at the time the invention was made to further provide a hydrogenation system to the modified apparatus of Banquy, on the basis of suitability for the intended use thereof, because the provision of a hydrogenation system helps maximize the production of further liquid hydrocarbon products from the Fischer-Tropsch reaction products stream, as taught by Ireland et al.

5. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Banquy (US 4,782,096) in view of Davis et al. ("Cryogenics for Syngas Processing", *Chemical Engineering Progress*, February 1980, pages 72-79) and Martin (US 4,102,659), as applied to claim 19 above, and further in view of Keller (US 4,650,814).

Banquy discloses that "[a]ny physical separation process can be used" in the physical separation zone and, in particular, "[a]nother physical separation for this purpose is the membrane separation process, which is described in Hydrocarbon Processing May 1980 pages 115-118, and July 1980 pages 65-67," (column 9, lines 55-68). The collective teaching of Banquy, Davis et al. and Martin, however, is silent as to the provision of a membrane separation system, for removing helium from the separated hydrogen product.

Keller (FIG. 3) teaches a membrane separation system 325 for removing inert gases 344 such as helium (see column 7, lines 6-17) from a separated hydrogen product stream 330. (see column 13, line 10 to column 14, line 34; see column 15, lines 10-36; see also FIG. 1, column 8, line 14 to column 9, line 8). It would have been obvious for one of ordinary skill in the art at the time the invention was made to further provide a membrane separation system in the modified apparatus of Banquy, on the basis of suitability for the intended use thereof, because the

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membrane separation system enables the generation of a high purity hydrogen stream for use as a recycle, while minimizing the amount of inert compound build-up in the system by separating and removing any inert gases, such as helium, from the system, as taught by Keller.

Response to Arguments

6. Applicant's arguments filed June 19, 2007 have been fully considered but they are not persuasive. Applicant (at page 11, second paragraph) argues,

“Applicant respectfully traverses the rejection and submits that the Office Action does not set forth a *prima facie* case of obviousness because the proposed combination of references is improper. For example, Applicant is unable to find in Davis its methane wash approach produces the first cryogenic liquid comprising unreacted carbon monoxide and unreacted hydrogen as recited in claim 19. The lack of such a first cryogenic liquid teaches away from including the “second liquid methane wash column” (or the second absorption zone 19 in Martin, see below) in the apparatus.”

As best understood, it appears that Applicant is arguing that there would have been no motivation to add a second methane wash column for removing hydrogen from the bottoms stream exiting the (first) methane wash column in the modified apparatus of Banquy, because Davis is silent as to the presence of any hydrogen within the bottoms stream exiting the methane wash column (of FIG. 2). The Examiner respectfully disagrees.

Davis teaches a “methane wash approach” (FIG. 2) in which a methane wash column produces an overhead stream containing “H₂ product” and a bottoms stream containing CO and liquid methane. The bottoms stream from the methane wash column is then fed to a CO/CH₄ fractionator for separating the CO from the liquid methane, where the CO exits as an overhead stream (labeled “CO product”) and the liquid methane exits as the bottoms stream, for recycling

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to the methane wash column and/or use as fuel.

Although Davis is silent as to residual hydrogen being contained within the bottoms, in addition to the CO and liquid methane, the Examiner asserts that one having ordinary skill in the art would have recognized that at least a certain amount of hydrogen would have remained within the bottoms stream exiting the methane wash column.

For instance, Martin (at column 1, line 46 to column 2, line 15) specifically comments on the prior art configuration in Davis:

“... In one conventional process arrangement employing such liquid-vapor contactors, the synthesis gas feed stream is provided at elevated pressure and cooled by heat exchange to form a vapor-liquid mixture which is introduced to the first contacting column. In the first column, the introduced feed is contacted with a chilled methane wash liquid for absorption of the carbon monoxide in the methane wash liquid. Hydrogen is obtained from the first column as carbon monoxide-free overhead product and bottoms liquid is recovered comprising methane and the absorbed carbon monoxide. The recovered bottoms liquid is then throttled to reduced pressure and fractionated in the second contacting column. From the second column, carbon monoxide is recovered as overhead and methane is recovered as bottoms. The methane bottoms are chilled and recycled as the aforementioned methane wash liquid for the first contacting column.

Although the above separation system entails a comparatively simple apparatus arrangement, the carbon monoxide product recovered by the process is unsatisfactory for use in most chemical synthesis applications by virtue of its relatively high hydrogen content. Accordingly, the prior art has attempted to obtain improvement in purity of the carbon monoxide product by removal of the hydrogen contaminant upstream of the second contacting column...” (with emphasis added).

Martin thus evidences that in a conventional processing scheme, hydrogen, in addition to carbon monoxide and liquid methane, are known to be present in the bottoms stream exiting the methane

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wash column (i.e., the first contacting column), given that a carbon monoxide product stream having “a relatively high hydrogen content” is recovered from the fractionating column (i.e., the second contacting column). Martin specifically sought to remedy this issue by providing a second methane wash column, interposed between a first methane wash column and the fractionation column (see comments in the rejection, above).

The Examiner thereby maintains that one having ordinary skill in the art of chemical engineering would have been motivated to modify the apparatus of Banquy according to the teachings of Davis and Martin, on the basis of suitability for the intended use and absent a showing of unexpected results thereof, because the physical separation process as conducted in the physical separation zone of Davis et al. is specifically suggested by Banquy as being suitable for use in the apparatus, and the provision of a second methane wash column achieves a substantial and unexpected improvement in recovery of high purity carbon monoxide relative to the prior art processes used for such separation, as taught by Martin (see column 5, lines 31-42).

In addition, one having ordinary skill in the art of chemical engineering would have recognized that the operation of a column under 100% efficiency (i.e., to achieve a complete separation, within a single column, of all hydrogen from the CO and liquid methane components) would have been highly uneconomical, if not impossible, given the high level of equipment cost and the high level of energy consumption required for operating such a column. As such, the Examiner asserts that some hydrogen would have inherently remained within the CO and liquid methane stream exiting the methane wash column as taught in Davis, and for this reason, it would have been obvious for one of ordinary skill in the art to provide a second methane wash column, as taught by Martin, for separating out an additional portion of the remaining hydrogen.

Conclusion

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

* * *


Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer A. Leung whose telephone number is (571) 272-1449. The examiner can normally be reached on 9:30 am - 5:30 pm Monday through Friday.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Glenn A. Caldarola can be reached on (571) 272-1444. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR

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system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.


Jennifer A. Leung
August 24, 2007


Glenn Caldarola
Supervisory Patent Examiner
Technology Center 1700